Pollution Probe.
Brief to the Ontario Advisory Committee on Energy. Toronto, 1972.

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Submission

by

POLLUTION PROBE

at the

UNIVERSITY OF TORONTO

to the

ADVISORY COMMITTEE ON ENERGY

July 1972

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probe Pollution Probe at the University of Toronto, Toronto 181, Ontario

BRIEF

to the

ONTARIO

ADVISORY COMMITTEE ON ENERGY

from

POLLUTION PROBE

at the

UNIVERSITY OF TORONTO

July, 1972

"The Government is determined to assure the adequacy of our energy supplies for the future. It will ensure that the energy is used as efficiently as possible and that its use will not adversely affect the environment, health or life".

Speech from the Throne
March 30, 1971

This paper contains recycled post-consumer waste.

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PREAMBLE

The quotation from the Speech from the Throne is a commendable and timely statement by the Government of Ontario. It indicates an awareness of the two basic problems which arise from energy use: depletion of energy reserves and environmental impact. The statement recognizes the importance of assuring future supplies, a goal which in our finite world is most likely to be realized through programmes designed to achieve the conservation of energy resources and the ultimate levelling off of energy demand. Emphasis is also placed on the most efficient use of available energy and upon measures designed to protect the environment and human health, presumably through strict government control. In the terms "determined to assure" and "will ensure", it implies a willingness on the part of the government to exercise its regulatory powers to actively enter into the market mechanism in order to achieve a balance of supply and demand and to minimize the harmful effects of energy use.

In fact, Pollution Probe accepts this quotation as foundation for an Ontario Energy Policy for the next 20 years. Accordingly, we will stress in this brief conservation of energy, efficiency of energy consumption and regulation of energy use for the public benefit. We will also examine the basic cause of our present concern with energy - unrestricted growth - and emphasize the need to resolve this fundamental problem in addition to the secondary problems or symptoms which it creates.

Pollution Probe's brief, therefore, proposes four basic principles to guide the formulation of an Ontario Energy Policy:

CONSERVATION
EFFICIENCY
TRANSITION TO A STABLE STATE
REGULATION

These four principles have far-reaching implications and give rise to a number of sub-principles and recommendations which are developed in the text of this brief. Pollution Probe presents these policy proposals for the consideration of the Advisory Committee on Energy so that it can make specific recommendations for achieving the

goals which the government espouses in the Speech from the Throne. By taking action now, it is hoped that Ontario will avoid the problems associated with the current United States "energy crisis" and set an example for our federal government and other provinces by formulating a progressive and responsible long-term energy policy.

GENERAL RECOMMENDATIONS

1. The Ontario Government should adopt a policy of encouraging the conservation of energy of all forms. It should no longer actively promote or condone the extravagant development and use of energy resources. In future, advertising and marketing policies, rate structures, bonus schemes and public information programs should be designed to encourage the conservation of energy by discouraging its unnecessary and inefficient use.

2. The Ontario Government should take stronger steps to ensure that energy is used as efficiently as possible. A clear energy policy should be established which actively encourages the most efficient use of each energy resource in all sectors of society. The government should ensure that the energy price structure adequately reflects the benefits to society of employing the most efficient available source.

3. The Ontario Government should recognize and acknowledge that exponential growth in resource consumption cannot continue indefinitely in a finite world. The ultimate goal of government should be to improve the quality of life for its citizens. This requires that narrow economic analyses be performed within a clearly specified social and environmental context, and that any subsequent development be fostered or constrained by explicit social and environmental policies. A de facto policy of maximizing economic growth is no longer appropriate, and institutions must be developed that will lead within a few decades to a virtual steady state.

4. The Ontario Government should form an Energy Regulatory Board to regulate and control the policies and practices of energy industries. In addition to enforcing the environmental principles already mentioned, the Board would require a comprehensive environmental impact statement, a broad cost-benefit analysis and the fullest possible public involvement before making a decision on any major proposal by the energy industries.

5. The Ontario Government should set an example for the Federal Government and the other provincial governments by establishing a progressive and responsible long-term environmentally-sound energy policy. Ontario should encourage the Federal Government to adopt policies which will complement and further this energy program.

ENERGY CONSERVATION AND EFFICIENCY

1. Introduction

Traditionally, western society has regarded its resources as unlimited and hence has viewed anything which will increaee consumption and production as "desirable". Thus, we get our present "throughput" economy which is based on the worship of Gross National Product. Now, however, with the recognition that we do not have unlimited reservoirs of anything on this earth, either for extraction or for pollution, we must try to find a place in a cyclical ecological system which is capable of continuous reproduction of its capital stock through harnessing available energy supplies. This has been called a "stock" economy and its goal is to achieve a given standard of living using the minimum amount of resources possible. By shifting our emphasis from maximizing throughput to maintaining our capital stock, the effective inflow and outflow from our economic system is minimized. This extends the lifetime of reserves and reduces the generation of waste products (pollution).

We will always need a continuous flow of energy into our "stock" economy simply because energy degrades when used and is not recyclable. There are, however, two primary methods of achieving a reduction in the through-put of energy:

i) to conserve energy resources rather than promote their use; that is, to avoid needless consumption, to use only those resources that are essential for the maintenance of our "capital stock".

ii) to use our essential energy more efficiently, to obtain more work per unit energy and therefore require less initial input.

2. Conservation

Because of our dedication to maximizing "throughput" and Gross National Product, the promotion and selling of one's product of service has become an overriding goal in our society. For example, although there are predictions that world petroleum reserves will be depleted in 30 to 40 years (1), there does not appear to be any action at present to reserve part of these resources for future needs in petrochemical synthesis, lubrication and certain types of transportation. The needs in these areas will probably continue indefinitely

yet we persist in our short-sighted policy of promoting a higher and higher rate of energy consumption.

If we are to establish a long-term energy policy consistent with a finite world, we should strive to use up our resources as slowly as possible rather than developing them wastefully at the fastest possible rate. Measures could be taken to reduce direct energy consumption and thereby conserve our resources. Such steps would have an immediate effect on aggregate demand and would be acceptable to most individuals. Examples of this type of conservation are: walking, cycling or taking public transit instead of driving; turning off electrical appliances when not needed, and avoiding energy-expensive or unnecessary products. The public is not aware of the need for such actions and, in an affluent society with artifically-underpriced sources of energy, the financial motive is not strong. Industry continues to promote energy usage in search of higher profits or simply in accord with the traditional "bigger is better" philosophy. Indeed, the only time we are told to conserve our resources is during an obvious emergency. The long-term imbalance between the supply and demand of our resources, given our present trends, has not been acknowledged by our government and the crisis which we are approaching is being ignored.

The government must recognize and appreciate the errors in our consumption pattern, make the public aware of the consequences of current trends, and develop and enforce appropriate regulations for industry. Up to the present, government has sided with business in promoting energy usage and most forms of growth. To continue to do so would be an abdication of its responsibility to the people. We can no longer afford to have industry promoting unlimited growth in energy demand and consumption through advertising, rate structures and bonus schemes. The government must now assume a more responsible role and serve the best interests of people (present and future) by taking steps to conserve our energy resources.

3. Efficiency

The term "efficiency" as applied to energy use can be defined as the fraction of the theoretical fuel energy which is obtained in a useful form. The unused or "lost" energy is accounted for by incomplete combustion, by energy which is liberated but not captured and therefore

lost in the exhaust, and by energy attrition during conversion from one form to another (eg. chemical to thermal to mechanical to electrical). Some examples of efficiency in the use of fossil fuels are: 60-80% for heating by means of furnaces, 25% for propulsion of automobiles, and 38% for thermal generation of electrical power.

Efficiency can also be interpreted as the ratio of "energy used" to "energy released" when only a fraction of the total fuel energy is released. This definition applies in the case of nuclear fuels where only a small fraction of the total energy content of the fuel is released (0.3% in CANDU reactors). As an example of efficiency in this context, nuclear power plants lose 2 units of energy as waste heat for each unit converted to electricity and the efficiency is therefore 33%.

There is no doubt that North American society uses its energy resources inefficiently and that, so far, governments have condoned and even encouraged these practices. Examples include: road construction for the great commuter traffic with many one-passenger cars, low standards for insulating buildings, willing assumption of the responsibility for disposing of energy-expensive packaging materials, acceptance of planned obsolescence, failure to recycle expensive metals, and tolerance of low efficiency of thermal electric generating stations.

High efficiency in energy use has two desirable consequences. Firstly, since less fuel is consumed performing useful work, there is a net conservation of fuel. Secondly, environmental degradation is reduced, since environmental impact is roughly proportional to the amount of fuel extracted, transported and consumed. Since increased efficiency of energy use is not always in the best interests of the suppliers of energy, it is up to the government to intervene on behalf of the consumer to ensure the most efficient use of our energy resources.

The following sections will examine areas in which we can achieve significant savings in energy use, either directly through conservation or indirectly through increased efficiency of consumption. Since the distinction between conservation and efficiency is often difficult and the net environmental effects of each are much the same, no attempt will be made to separate the potential savings of each.

4. Efficiency of Energy Use in Transportation

Despite the widely acknowledged existence of a "transportation crisis", the government has been slow to take steps to encourage those

means of transportation which have the least environmental impact. In fact, under the present price structure, certain forms of transportation desirable from an environmental standpoint are effectively discouraged compared to alternative methods. Because of the government's stated commitment to efficiency, this brief will analyze various forms of transportation in terms of their effects on energy consumption and the environment. Further, we will suggest means whereby the government could implement its publicly stated objectives.

a. Inter-City Freight Transportation

Table 1 compares the efficiencies of railroad, highway, and air transportation in the U.S. in the mid 1960's.

Table 1. ANNUAL TRANSPORTATION STATISTICS FOR U.S. IN MID 1960s (2)

	LOAD (gross ton-miles x 10^9)	FUEL (gal x 10^9)	EFFICIENCY (ton-miles/gal)
Railroad	2,200	4.0	550.0
Highway	1,320	35.2	37.6
Airlines	60	2.0	30.0

It is apparent that, in terms of gross ton-miles moved, railroad transportation has an efficiency 15 times that of highway transportation and 18 times that of air transportation. In terms of net freight moved, railroads have a net propulsion efficiency (NPE) of nearly 200 cargo ton-miles/gal, while trucks have an NPE of 50 cargo ton-miles/gal, and airfreight has an NPE of only 5 to 10 cargo ton-miles/gal (2). In spite of the relatively low efficiency of truck transportation, truck freight has been increasing at a rate of 5% per year while rail freight is increasing at a rate of only about 1% per year in the U.S. (3). The energy expense is not completely displayed by the above figures since roads must be built and repaired to accommodate the trucking industry. It has been calculated that construction of expressways uses 3.6 times as much energy as the construction of the same length of railroad (3). The road-building industry not only requires

much energy but also depletes the area of arable land. Since railway lines are already available to most parts of the country, future transportation needs would require little additional construction. Even where new routes would be needed, a railway uses one-fourth the right of way required for a 4-lane highway (3).

b. Inter-City Passenger Transportation

Man's innovations in the field of transportation have become less and less efficient and today's more exotic and faster forms of transit, particularly the airplane, are very extravagant consumers of energy. Even the car is more efficient than today's planes. Of the projected growth of petroleum consumption in the U.S. from 1960 to 1990, air and automobile transit will be responsible for more than 92 per cent (2).

Other more efficient forms of transport with less environmental impact than cars or planes should be developed. The congestion at major airports could be substantially reduced by eliminating flights that link major centres not more than one hour apart by air. Instead, high speed surface transport could speed passengers between major centres in comfort and safety. The 150 mph Japanese Tokaido Line, for instance, carries 8,000 people per hour and is at least three times as efficient as airplanes in terms of energy consumed per passenger mile. More money must be spent for the development of these alternate forms of transport in order to make them viable within 5 years.

c. Urban Transportation

One of the greatest energy inefficiencies in modern society is the transportation of people in cities.

Table 2. EFFICIENCY OF VARIOUS MEANS OF URBAN TRANSPORTATION (2)

Vehicle	Net Propulsion Efficiency (Passenger miles/gal)
Electric Trains	75 - 100
Bus	100
Automobile (Average)	30 - 40
Automobile (1 Person)	7
Motorcycle	160
Bicycle	1000

It is seen from Table 2 that the automobile is the least efficient means of transporting people in cities. Despite this, the private automobile is by far the most popular form of urban transportation. This is shown by the total volumes of petroleum (or electrical equivalent) used by the various classes of urban vehicles (Table 3).

Table 3. TOTAL ENERGY CONSUMPTION FOR URBAN TRANSPORTATION U.S. ANNUAL MID 1960s (2)

Vehicle	Energy Used (millions of gallons)
Trains	70
Buses, Taxis, Limosines	400
Private Autos - trips of more than 2.5 miles	14,000
- trips of less than 2.5 miles	21,000
Trucks and Parcel Delivery	5,400
Institutional Vehicles	1,800
Total	42,670

Thus, 82% of all energy used for urban transportation per year in the U.S. in the mid 1960's was consumed by private automobiles and of that, 60% was used in trips of less than 2.5 miles. This disproportionate use of private automobiles has continued unchallenged despite the gross inefficiency (Table 2) and the serious contribution which automobiles make to pollution (See Appendix I). City and provincial governments continue to provide wider and wider roads to accommodate the automobiles, with apparent disregard for the problems which they create and for the alternatives which exist.

The alternatives are: greatly increased use of public transportation and/or the use of bicycles. The obvious large-scale solution is to build adequate public transit and to make it more attractive than the private automobile. The latter could be achieved by making the public transit fast, convenient, efficient and relatively inexpensive and by discouraging the use of auto-

mobiles. The public system should include buses, commuter trains, street cars, subways, mono-rails and new efficient innovations in public transit. A system of buses could be made highly efficient by setting aside certain streets or lanes for buses only during rush hours. Many of these buses could be express buses travelling at high speed from points in the suburbs to stopping points in the centre of the city. Such a system could be introduced almost immediately.

Making automobile owners pay the real cost of operating a car in the city would be one fair and effective way of discouraging their use. At present, there is no mechanism to ensure that a driver compensates society for the burden which he places upon it when he decides to use his car. Because of this and the obvious bias of government funding procedures in favour of private means of transportation, car users are heavily subsidized. Various methods have been suggested to equate the benefits and costs of using a car. These include: substantially increasing parking fees (achieved by taxing private lots as a business), levying a toll on each vehicle as it enters certain zones of the city (which would be inversely proportional to the number of people in the car) and/or increasing the price of gas in the city. Conversely, mass transit users should find the benefits accruing to society of their not using a car, reflected in the fare structure.

Such a move, we feel, would effectively tip the scales in favour of public transit and improve the quality of life in our cities.

On the same note, we would like to see incentives to encourage automboile owners to use a cleaner form of fuel. Under the present system, ecologically desirable fuels such as non-leaded gasoline and propane are not used in large quantities because there is little economic incentive to do so. Similarly, efforts should be made to encourage the purchase of smaller cars rather than the larger models with their excessive use of resources for construction, voracious appetite for energy, and greater waste of urban space.

The increased use of bicycles is not a frivolous suggestion. Many trips of less than 2.5 miles could be made by bicycle or by

walking. Bicycles are used in European cities. Bicycling and walking are health promoting and recreational except where the overwhelming number of cars in urban areas makes these activities unpleasant and hazardous. Certain streets in each city should be set aside and closed to automobile thoroughfare at all times. A network of these streets, utility rights of way, ravines, parks and "bike ways" would provide access to all parts of the city.

(d) Recommendations

i) The Ontario Government should discourage the unnecessary and inefficient use of all forms of transportation. Positive steps to this end should include:

(a) Ensuring that a more accurate reflection of the costs and benefits to society of an individual undertaking any trip are included in the cost of the transportation.

(b) Encouraging the loading to optimum capacity of all forms of transportation. Partial loads of either passengers or freight should be discouraged.

(c) Encouraging a decentralization of offices and industries so that the distances between residential, recreational and work areas are reduced.

ii) The Ontario Government should recognize and encourage only those means of transportation which are the most efficient and which have the least environmental impact by:

(a) Providing incentives for shipping by train and boat rather than by truck or plane.

(b) Intensifying the research and development of fast, efficient surface transport so as to reduce the need for short-distance plane flights.

(c) Encouraging the construction and use of urban public transit systems at the expense of the private automobile.

iii) The conversion of urban vehicles to liquid natural gas and propane and the use of non leaded gasoline should be encouraged by tax incentives and other methods.

iv) Further incentives should be introduced to encourage the use of smaller vehicles and low horsepower engines.

v) The use of bicycles in congested urban areas should be promoted. Construction of a bike way system using a combination of utility rights of way, ravines, parks and on-street bicycle lanes should be undertaken which will link together commercial downtown areas and surrounding residential areas.

vi) Large scale urban and suburban public transit should be promoted through the following means:

(a) Encouraging and assisting cities in selecting the most efficient mass transportation system for their area.
(b) Increasing substantially the amount of money available for mass transit systems in Ontario.
(c) Introducing immediately, reserved lanes or streets for express buses to link suburban and downtown areas.
(d) Making urban public transit free of charge to the general public as well as fast, efficient, comfortable and pleasant.

vii) Use of the private automobile should be discouraged, particularly in downtown urban areas, through such means as:

(a) Converting streets lined with many small shops into malls for the exclusive use of pedestrians.

(b) Increasing car parking rates, especially for day-long parkers. This could be achieved by taxing parking lots at the business rate.

(c) Abolishing all on-street parking in the downtown sector and permitting parking on both sides of the street in residential neighbourhoods.

(d) Raising the price of gasoline, particularly within the city.

(e) Ultimately banning the use of private internal combustion vehicles in the downtown area.

5. Product and Package Durability

(a) Non-Returnable Bottles and Cans

In the early 1950's the steel industry entered the beverage container field on a competitive basis and aluminium containers have since been introduced into some markets. Following this, disposable containers became popular, and in order to remain competitive, the bottle industry introduced non-returnable bottles on a large scale. As a result, in the U.S., returnable bottles have decreased from 98% of the soft drink market in 1958 to about 60% in 1971, with 32% predicted in 1976. In the beer market, they have decreased from 58% in 1958 to about 25% in 1971 with 20% predicted for 1976. This conversion has occurred despite the fact that beverages in non-returnable containers cost the consumer 30% more than the same quantity in returnable containers.[4]

On the basis of energy consumed, it has been shown that non-returnable containers are 3 to 4.4 times more energy expensive than returnable ones when all factors in manufacturing, processing and recyling are considered.

TABLE 4

ENERGY RATIOS FOR VARIOUS BEVERAGE CONTAINER SYSTEMS

(The Energy per Unit Beverage Expended by a Throwaway Container System Divided by the Energy per Unit Beverage Expended by a Returnable Container System)*

Container Type					
Throwaway	Returnable	Quantity	Beverage	Returnable Fills	Energy Ratios
Glass	Glass	16 Oz.	Soft Drink	15	4.4
Can	Glass	12 Oz.	Soft Drink	15	2.9
Glass	Glass	12 Oz.	Beer	19	3.4
Can	Glass	12 Oz.	Beer	19	3.8
Paper	Glass	1/2 Gal.	Milk	33	1.8
Plastic**	Plastic	1/2 Gal.	Milk	50	2.4

*Without remelting loop (discarded bottles and cans are not returned for manufacture).

**High density polythylene.

It is important to note that the energy cost of retrieving scrap glass from waste is far higher than the energy cost of mining raw materials and that, therefore, from any energy standpoint, it makes little sense to recycle, in the sense of remelt, either returnable or throwaway bottles.(4) Recycling centers for throwaways are essentially public relations activities which direct the concern of many citizens away from the need to buy re-usable containers in the first place.

The total energy used in beverage containers in the U.S. in 1970 was 0.34% of the national energy demand or 7 X 10^{10} kwh. This quantity could be reduced by 55% if the system were to convert

completely to returnable containers. The industry is not interested in conserving this energy since the disposable containers bring about greater industrial activity and greater profits.

The exclusive use of returnable containers would not only conserve a significant amount of energy, but would benefit society additionally by reducing beverage costs by about 30% and by alleviating the pollution created by discarded containers.

There are several means to achieve this conversion to returnable containers. The first is a deposit on disposable containers which is equal to the deposit on returnable bottles. The second is a disposal tax on non-returnable containers. The third is an outright ban on non-returnable beverage containers.

(b) Product Durability

One of the major inefficiencies in our society is the rapid turnover of consumer goods. The rapid obsolescence of goods is planned by the manufacturing industry in order to increase sales. This is achieved by industry in at least two ways: style change and poor quality construction. Style change is exemplified by the clothing and automobile industries. People have been led to believe that they must buy a new car and new clothes every year in order to appear fashionable. Poor quality is a more insidious form of designed obsolescence. It leads to rapid discard of goods and, besides depleting energy and resources, it contributes to the waste problem. It is particularly conspicious in the automobile industry where vehicles are designed in such a way that repair and replacement of parts is made difficult. Moreover, it would appear that auto bodies are designed to facilitate rather than to prevent rusting; corners and narrow crevices which collect salt are retained from year to year rather than being eliminated or covered by protective panelling.

Substantial improvement in energy efficiency could be achieved if industry made an honest effort to give the consumer the greatest value for his money.

(c) Recommendations

i) The Ontario Government should require the re-use of products and packages where it is technically feasible. A ban should be imposed on products and packages designed and/or designated to be "disposable" where the technology exists to produce and market re-usable items. Standardized and returnable containers for a wide range of products should be required and unnecessary packaging should be prohibited.

ii) Advertising whose primary objective is to induce an artificial demand for a product should be banned. Standards should be imposed which require that only relevant facts about a given product be stated in any advertisement. Advertising should not be a deductible expense for businesses, except under specially designated conditions.

iii) The Ontario Government should actively encourage the manufacturing and marketing of highly durable, easily repaired and long-lasting products within the province. A durability tax which is inversely proportional to the expected life of a product should be introduced. In addition, the cost to society of disposing of any product should be included in its retail price.

iv) A Consumer Review Division should be established within the Ontario Government - composed of a broad cross-section of consumers and including specialists in economics, ecology, sociology, law, business and engineering - to examine and review all new products appearing in Ontario. The Division should have the power to ban any product that is not environmentally, socially or economically sound.

6. Recycling

In the previous section we looked at the need to design our products and packages so that they could be re-used many times. Some materials, however, are not readily re-usable in their initial form, but can be reprocessed or recycled at a considerable energy saving relative to manufacturing a product from virgin resources. When re-use is not feasible,

recycling should be considered. We will look at several major areas where energy consumption and environmental degradation could be reduced through an extensive recycling program.

(a) Metals

The amount of energy used in production of metals varies greatly depending on the type of process used for purification. Metals, such as iron, which can be extracted and purified by mechanical and chemical processes, utilize relatively little energy per ton produced, whereas metals such as aluminum, magnesium, or titanium, which are purified by electrolysis, require considerably greater amounts of energy. Table 5 shows the quantities of energy used to produce several metals from ore, taking into account the energy requirements of all operations from mining the ore to casting the refined metal.

TABLE 5

ENERGY REQUIREMENTS FOR PRODUCTION OF METAL (5)

Metal	Total Energy for Production kwh per ton (converted to eqvt. coal energy)	Percent of Total which is Electrical
Iron	3,300	1%
Aluminum	51,600	70%
Magnesium	91,000	40%
Titanium	134,700	75%

The manufacturing industry during the last 10 to 15 years has shown a marked tendency to replace steel by the more energy-expensive metals. This is demonstrated by the fact that steel production has been increasing at a rate of 1.5% per year, while the annual rate of increase for aluminum is 7%, for magnesium 8%, and for titanium 13% to 15%. The reasons for this change include the light weight and corrosion resistance of the latter metals. A significant fraction of the aluminum produced is used in packaging. The magnitude of the energy utilization for metal production is shown by the predicted 1980 production in the U.S. of 112 million tons of iron, 9 million

tons of aluminum, 170,000 tons of magnesium, and 51,000 tons of titanium. (5) The conversion from iron to lighter metals represents a formidable increase in energy expenditure.

There is a growing awareness that high grade ores of many metals are nearing exhaustion. As high grade ores are depleted, it will be necessary to use ores of lower grade or more difficult extraction. The energy requirements for each available ore has been calculated. Some examples are given in Table 6. As the lower grade ores are used, the energy expenditure will increase.

TABLE 6

ENERGY REQUIREMENTS FOR PRODUCING METALS FROM DIFFERENT SOURCES (5)

Metal	Source	Total Energy for Production (kwh per ton) (converted to eqvt. coal energy)
Iron	hematite (58%-59% Fe)	3,300
	magnetic taconite (22-35% Fe)	3,600
	specular hematite (40-50% Fe)	4,200
	non-magnetic taconite (28-40% Fe)	4,300
	laterite (40% Fe)	5,300
Aluminum	bauxite (50% alumina)	51,600
	bauxite (30% alumina)	59,900
	clay (30% alumina)	66,800
	Anorthosite	72,600
Copper	porphyry (1% CuS)	14,200
	porphyry (0.3% CuS)	25,000

Recycling of metals offers a partial solution to the problems outlined above. The reclaiming of some metals, such as aluminum, copper, and titanium, is considerably less energy-expensive than obtaining them from raw ores.

TABLE 7

ENERGY REQUIRED TO RECYCLE METALS COMPARED WITH ENERGY FOR PRODUCTION FROM ORES (5)

Metal	Energy (kwh per ton)	Energy Saving from Recycling (% of total)
Aluminum from bauxite	14,600 (electrical)	
Aluminum from pure scrap	160 "	98.9%
Copper from 1% ore	14,200 (eqvt. coal energy)	
Copper from 98% Copper Scrap	800 "	94.4%
Copper from Impure Scrap	1,561 "	89.0%
Titanium from high grade ore	134,700 "	
Titanium from pure scrap	39,000 "	71.1%

Comparable values for recycling iron are not readily available. However, it is likely that recycling scrap iron does not use significantly less energy than the production of iron from ore. This is due to the fact that scrap iron is smelted in electric furnaces, which have high energy demand, while iron ore is smelted relatively efficiently in the blast furnace.

Some metals are effectively recycled at present; 55% of U.S. iron production is said to be from recycled scrap (6), 20% of aluminum and 25% of copper. Many metals cannot be recycled effectively, e.g., 90% of titanium is used in dissipative products such as paint. Metals, such as aluminum, which are dissipated to an intermediate degree, require considerable energy in sorting the product from other refuse. Processes are being developed for recovering metals from incinerator ash and may lead to greater recovery of aluminum.

(b) Paper

Although exact figures for the energy expenditures for producing paper from pulp and from scrap paper are not available, it appears that recycled paper is less energy-expensive than virgin paper. It has been estimated that newsprint pulp from virgin fibre requires 77 horsepower-days per ton, while wastepaper pulp requires 57 horsepower-days per ton, a saving of 26%. (7)

(c) Recommendations

i) The Ontario Government should adopt a policy of encouraging the efficient recycling of all materials which cannot be re-used in their original form. The manufacturing of goods from recycled materials should be encouraged at the expense of using more virgin resources. Methods to achieve this goal should include:

(a) Establishing an education program designed to explain to the public the need to recycle resources and the ways to achieve this objective.

(b) Supporting additional joint engineering and sociological research into methods of recycling metals, glass and paper.

(c) Establishing preferential purchasing policies for recycled materials by the government and all of its agencies.

(d) Abolishing all tax concessions, depletion allowances, preferential freight rates, development grants and other financial incentives for primary and resource extracting industries. This would provide a more competitive market for material from recycled resources without encouraging growth in the overall consumption of resources.

ii) In addition, the Ontario Government should consider introducing one or more of the following:

(a) A virgin resources tax which was inversely proportional to the availability of each particular resource. This tax would be designed to ensure that the reserves of each of our resources lasted as long as possible.

(b) An indirect recycling subsidy in the form of a tax on all products inversely proportional to the relative amount of recycled material used in manufacturing the product.

(c) The establishment of a development loan fund for recycling industries.

7. Synthetic Products

The foregoing examples of replacing railroad freight by truck freight, replacing refillable bottles by disposable containers, and replacing iron products with aluminum products demonstrate a general trend toward more energy-expensive goods and services.

During the past 15 to 20 years, there has been a marked trend toward replacement of natural (renewable) products with synthetic products. Some examples of this process are the replacement of cotton, wool, and silk clothing by synthetic materials, paper packaging by plastic or metal foil, soap by detergents, leather by plastic, etc. In each case, the synthetic product is considerably more energy-expensive than the natural one. The natural products use mostly "free" energy derived from sunlight either directly in plant products or indirectly in animal products. Variable amounts of additional energy go into the processing of these products. Additional features of these natural products are that the starting materials (carbon dioxide and water) are also largely free, and the products are biodegradable after being used. In the case of synthetic products, large amounts of energy are expended in synthetic processes. These processes frequently involve many steps, each of which is endothermic. In addition, these products use up non-renewable resources, and they are biologically indestructable after being discarded. The differential energy expenditures for synthetic products relative to natural ones is estimated to be significant and steps should be taken to ensure that the continuation of this trend is discouraged. (3)

(a) Recommendation

The Ontario Government should discourage the present trend of replacing natural products with synthetic ones. Where synthetic products require a greater overall energy input in production, distribution, sale and disposal, a tax which is proportional to the increased energy requirement should be placed upon the product. Those synthetic products which remain on the market should be designed with ecological, physiological, sociological and disposal problems in mind.

8. Residential Energy Use

Residential use accounts for about 30% of total energy consumption (U.S. 1970) (8) and for about 25% of electrical energy consumption (Ontario 1970). (9) Of the energy consumed in the residential sector, 80% is derived from gas and oil and 17% is electrical (U.S. 1969), (10). In the household, the major consumption of energy is for space heating, followed by water heating, stove, refrigerator, freezer, air conditioner, and other uses.

(a) Space Heating

Space heating is achieved either by direct use of fuels in a home furnace or by indirect use through electricity. Most heating in Ontario involves direct burning on site, but electric heating has been gaining popularity. Heating by direct burning of oil or gas in home furnaces is 60-80% efficient in the conversion of fuel energy to heat.

There are two types of electrical heaters: resistive electrical heaters and heat pumps. Resistive heaters convert electrical energy to heat with near 100% efficiency. Heat pumps operate like air conditioners in reverse and concentrate heat from outside to the inside of the building. They accumulate heat with an efficiency of 200%, i.e., the heat accumulated is two times the electrical energy used. This efficiency is achieved only when the outside temperature is above 40°F. Efficiency decreases rapidly as temperature drops. In freezing temperatures, the coils tend to ice-up and lose their effectiveness. Therefore, heat pumps have little promise for use in Canada.

Since electrical generators are only 30-40% efficient in converting fuel energy to electrical energy, and since home furnaces are 60%-80% efficient, the use of electric home heating consumes about two times as much energy as direct burning.

Insulation is a major factor in determining the amount of energy needed to heat and cool a building. Houses designed for electrical heating are especially well insulated in order to make this means of heating economically competitive. However, if similar insulating standards could be adopted in homes using direct heating, the energy saving would be considerable.

Aside from efficiency, another important consideration is the pollution generated from various methods of home heating. Table 8 shows the emissions in pounds produced in heating an average Toronto home for one year by direct use of fuels in a furnace and by indirect use through electricity. An average efficiency of 70% is assumed for home furnaces and an overall efficiency of 35% for electrical heating (taking into account an efficiency of 38% in generation with some loss during transmission). The calculation of the values in Table 8 is shown in Appendix II.

TABLE 8

AIR POLLUTANTS (POUNDS) PRODUCED IN HEATING AVERAGE TORONTO HOME FOR ONE YEAR

	Gas Furnace	Oil Furnace	Electric Heating
Nitrogen Oxides (NO_x)	8.5-17	14.4	93.9
Sulphur Dioxide (SO_2)	0.1	68.0	380.0
Particulates	3.2	12.0	7.4
Total	22.0	106.4	488.3

It is seen that direct heating with gas is the least polluting means of home heating. Heating by oil furnace is considerably more polluting than by gas furnace. Electric heating produces approximately six times as much NO_x and SO_2 as the oil furnace. It should be noted that the values for electric heating in Table 8 are based on the average yearly energy mix used for generating electricity. Although exact figures are not available, it is likely that during the winter peak the percentage of coal in the electrical generation mix is greater than 41%. Thus, the values for electrical heating are probably artificially low.

It is potentially easier to control emissions from a few large central plants than from numerous small sources. The values given in Table 8 are for direct burning of fuels in well adjusted home furnaces.

Undoubtedly, many furnaces are improperly maintained and consequently release greater quantities of pollutants. However, tighter controls could be required which would overcome this problem.

At the present time, it must be concluded that direct burning of gas (or oil) is highly preferable over electric heating. However, conditions in the future may change so that the opposite conclusion may be true. For example, if the energy mix for generating electricity were largely nuclear, or if highly effective pollution abatement were feasible on central plants, then it might be desirable to use electric heating rather than direct burning. The best that can be said about electric home heating is that it is premature.

(b) Other Uses of Energy

Other uses of energy in the residential sector are mainly electrical. The major residential uses for electrical energy are water heaters, stoves, refrigerators, freezers, and air conditioners, each unit using more than 1000 kwh per year and cumulatively using 74% of total household use. Water heaters have the highest energy demand of any appliance, using over 4000 kwh per year. (10) Gas water heaters use only half as much energy as electric water heaters and widespread use of gas for water heating would represent a major reduction in energy demand. Appendix III contains a list of the ways in which residential energy use can be reduced.

(c) Recommendations

i) The Ontario Government should require that Ontario Hydro and all Municipal Electric Associations immediately abandon all forms of promotion of electric space heating and electric water heating. This includes promotion through advertising, unjustified financial incentives for installation, rate structures and public relations programs.

ii) Further, the use of natural gas in the home for space and water heating should be encouraged and the use of electricity for these functions should be discouraged at the present time. Incentives could be introduced which encourage the installation of an environmentally desirable energy source in new homes at the construction stage.

iii) The Ontario Government should adopt stricter insulation standards for all new buildings as soon as possible. Existing buildings could also be required to upgrade their insulation.

iv) Regular maintenance checks of all furnaces should be required to ensure that they are operating at their most efficient level.

9. Efficiency in Generating Electrical Energy

(a) Limitations of Current Methods

Current methods of electricity generation are grossly inefficient; fossil-fueled generators are 38-40% efficient and nuclear plants are 30-33% efficient. This means that for every kilowatt of electrical energy produced, 1.5 to 2 kilowatts of energy are wasted in the form of heat.

The main factor limiting efficiency is the lack of temperature-resistant metals. According to thermodynamic principles, the efficiency of energy conversion increases as operating temperature rises, reaching 90% efficiency at 2800° C. Structural metals currently in use in generating plants cannot withstand temperatures greater than 1000° C. Alloys capable of withstanding 2000° C have been developed for aircraft turbines and are now being adapted to gas turbine electric generators. Alloys and ceramics capable of withstanding 2800° C have been achieved experimentally and are likely to be in commercial use by 1985.

When temperature-resistant materials are available, efficiencies of at least 60% will be achieved in electricity generation. This will involve the use of sequential generators in "top" and "bottom" plants. The hot compressed gases will be used in a gas turbine and subsequently to generate steam for one or two steam plants.

Another futuristic means of increasing efficiency is the use of "direct conversion" of energy. This may be possible in Magnetohydrodynamics (MHD) plants and in fusion reactors.

(b) Total Energy Use

The concept of total energy use appears to be one of the most promising means of improving efficiency in energy use, with predicted efficiencies as high as 85%. This system uses an on-site electric generator powered by either a gas turbine or a diesel engine coupled with a heat exchanger which recovers the waste heat for other uses. The gas turbine is fuelled with natural gas and the hot gases from the turbine go directly into a boiler to generate steam. The diesel engine is fuelled with oil and is cooled by a water jacket, the heat is recovered from the water jacket and from the exhaust. The recovered heat can be used for a variety of purposes, depending on the demands. It is used for heating buildings, for air conditioning by means of the absorption chiller, and for industrial processes such as evaporation, distillation, desalination, etc.

This system is ideally suited for hospitals and universities and large commercial buildings which have fairly constant demands for both electricity and heat (or airconditioning). It is also attractive to shopping centres and apartment buildings, and to certain industries. In addition, it is recommended for isolated areas where power transmission is difficult. The units come in a number of sizes and have proved themselves to be highly flexible and reliable.

It would appear that the widespread use of total energy units would result in a very significant conservation of energy. With more than twice the efficiency of public electrical generators, they use less than half as much fuel for the same energy output. The only reservation about them lies in the relative controllability of pollution since a few large plants are more easily regulated than numerous small ones. However, experience to date would indicate that this potential drawback has been more than offset by the greater efficiency of energy conversion.

(c) Recommendations

i) The Ontario Government should require that additional funds be spent on the research and development of cleaner and more efficient ways of supplying the province's energy requirements.

ii) The Ontario Government should encourage the development and installation of total energy units.

EXPONENTIAL GROWTH AND ENERGY IN ONTARIO

1. Introduction

The underlying goal of any society should be to provide for its citizens a rising, or at least stable, quality of life. Security, health, comfort, justice; aesthetic, intellectual and physical pleasure; and a reasonable standard of living are encompassed in this objective. Traditionally, our society has accepted that the chief means to this end is through a growing economy. Thus most governments have made growth, development, expansion and maximum resource throughout ends in themselves and have, in the process, often lost sight of the real goals.

In the past growth may have been the only means to society's ends, but there is mounting evidence that not only are the consequences, side effects, and costs of traditional economic growth now threatening the goals for which we strive, but also our very existence as a society.

There can be little dispute with the position that exponential growth cannot continue indefinitely in our finite world. The laws of nature and the limits to energy and resources will eventually bring it to an imposed end. Rather it is a question of how growth will be stopped. If we accept that growth should be terminated in a voluntary and humane manner rather than involuntarily through a collapse in the life-support systems of this planet, then we must learn how the switch to a steady state society can best be orchestrated in order to provide a smooth transition and a truly high quality of life for all.

Aside from the very real limits to expansion on this planet, we should also determine if continued growth in the short term is the best means to achieve our society's goals. We know growth will be stopped eventually (either voluntarily or otherwise), but Pollution Probe feels that even now the costs associated with our present form of economic growth are exceeding the benefits and that the steady-state system offers a better alternative for achieving the objectives of society.

In subsequent sections we shall relate these concepts to energy and to Ontario and will make some positive suggestions for dealing with this question.

2. Exponential Growth in Ontario

In an unrestricted system, growth does not progress by means of constant increments per unit time (i.e. linearly). Since the base for further growth is constantly expanding, the increment per unit time is continually becoming greater. This is the characteristic of exponential growth. It is familiar to anyone with a savings account where interest on cumulated interest causes the capital to increase by greater and greater amounts as time goes on. Itcan be exemplified simply by a series in which '2' and its products are repeatedly doubled, i.e., 2,4, 8, 16, 32.... The first increment is 2, the fourth is 16, eight times the first. This feature of exponential growth has frightening implications when applied to human activities. No problems would arise in an unlimited system or in a system where the limits are very broad relative to the demands, as in earlier stages of development. But in a finite system, the limits are ultimately approached and one additional doubling of human activities will suddenly surpass the limits, with consequences which are difficult to imagine.

The Province of Ontario is an example of especially rapid exponential growth. The growth rate in Ontario is the greatest of any Canadian province aside from British Columbia. The greater growth rate will cause Ontario to approach the limits to growth more quickly and earlier than places with lower growth rates. Therefore, Ontario must give early consideration to the factors which will become limiting and plan well in advance how the crisis can be avoided. It is the responsibility of government as planner and policy-maker to do this assessment and to take appropriate action in the public interest. The obvious solution to the problem of approaching growth limits is to decrease growth rate with eventual attainment of a steady state ("no growth") system. The problem which government must face is how the deceleration can be achieved without impairing the welfare and prosperity of the citizens while actually improving the overall quality of life.

3. The Special Relationship of Energy to Growth

Throughout history the availability of energy has had a great influence upon the rate of economic growth. One can trace the pattern of increasing human productivity through the exploitation of energy from the first use of draught animals, to water wheels, to steam engines,

to internal combustion engines and electricity, and finally to jet propulsion and nuclear energy. If, at any stage of this sequence, the new form of energy had not become available, further growth would have been stifled. In fact, energy and growth are inter-related, in a vicious cycle whereby abundant energy stimulates new economic growth and the increased economic structure then demands more energy.

It is difficult to determine now if our capacity to produce energy will be one of the first factors to limit growth. If the technology becomes available (a rather tenuous assumption), we may be able to generate vastly increased amounts of electricity through fusion or solar power in the next century. Whether this new technology will be developed in time to replace our rapidly depleting current sources of energy is very much an open question. And even if we are able to hurdle this gap, there will continue to be a serious global maldistribution of energy and no guarantee that the many other forms of energy that would still be required could be produced in sufficient quantities. In any case, all energy is eventually transformed into heat and, given our present rate of growth in energy production, we will reach global heat limits in one to two centuries. In addition to this problem, a generous energy supply may be a curse rather than a blessing since (1) an energy crisis might be the least traumatic way for a civilization to realize its limits, and (2) abundant energy will prompt continued growth thereby accelerating the approach of other crises and making them more devastating when they occur. Therefore, a conservative and even restrictive use of energy may be the most effective means of slowing growth and moving toward a steady state.

4. Limits to Growth in Ontario

It may appear that Ontario is blessed with an abundance of space, fresh water, agricultural land, forests and minerals. However, this abundance is only relative and the situation may change quickly when current demands go through one or two more doublings. In the case of non-renewable resources, the supply is also relative to time and responsible planning must take into consideration the needs of future generations.

In relation to the world as a whole, Ontario cannot set itself apart. As a highly industrialized society with relatively few people, we consume a disproportionately large fraction of the world resources and produce a correspondingly large fraction of the world pollution. We cannot

take the position of recommending that this disproportionate distribution of material goods be continued. At the same time we cannot recommend that the per capita consumption in undeveloped countries be raised to equal our own since this alone would surpass the world limits. The only conclusion from the two above statements is that we must minimize consumption in this country while the less developed countries increase their consumption.

In this context, the limits to growth in Ontario are the same limits that apply to the world as a whole. These limits are summarized briefly below:

(a) Energy

As pointed out above, energy may not be a growth limiting factor if the necessary new technology is developed as needed. A particular concern with energy is in insuring that an appropriate "energy mix" is maintained so that certain energy sources are not exhausted before the need for them has passed. This is especially pertinent to the fossil fuels. For example, Dr. R. E. Folinsbee has calculated that Canadian conventional oil reserves will be virtually depleted by the year 2000. (11)

Natural gas will be needed far into the future to provide fuel for certain demands which cannot be met by alternate resources. Similarly, petroleum will be required in the distant future for chemical synthetic processes, for lubrication, and for certain transportation needs. An adequate reserve must be set aside to meet these anticipated future needs. In order to fulfil our responsibility to future generations, we must plan carefully now and adopt an energy mix which will balance the supply with the demand. This balance is most likely to be achieved through twin programs directed at both developing, in a rational manner, new fuel sources and new energy technologies and reducing the growth of energy demand. Adequacy of energy supply is much easier to guarantee under conditions of stable demand than under runaway demands which double every seven to fifteen years.

(b) Space

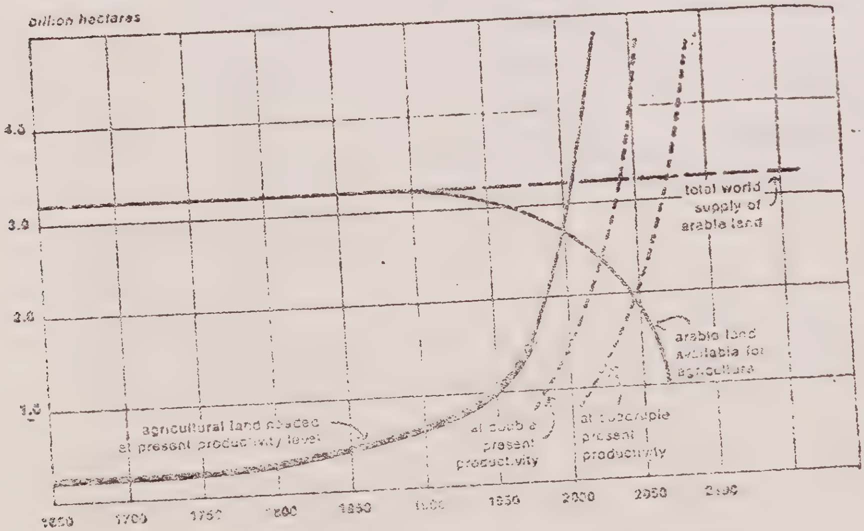
Despite the relatively low overall population density of Ontario, our numbers are becoming increasingly concentrated in the southern fringe of the province. Unfortunately, this is an area of high agricultural potential, and urban development is rapidly devouring large portions of rich farm land. Secondly, this pattern of development is producing huge centres of congestion and pollution. The area bound by Niagara Falls, Guelph, Barrie and Oshawa appears destined to become a gigantic megalopolis.

Ontario policy makers should study the problems which excessive size has caused in cities such as New York, Los Angeles and Tokyo and should plan to avoid these problems by encouraging development of smaller cities widely distributed over the province.

(c) Food

Food supply is a global problem.

ARABLE LAND (1)



Total world supply of arable land is about 3.2 billion hectares. About 0.4 hectares per person of arable land are needed at present productivity. The curve of land needed thus reflects the population growth curve. The light line after 1970 shows the projected need for land, assuming that world population continues to grow at its present rate. Arable land available decreases because arable land is removed for urban-industrial use as population grows. The dotted curves show land needed if present productivity is doubled or quadrupled.

As the preceding diagram illustrates, there will be a food shortage by the year 2000. Even if various technological advances are introduced, it will take only a few more decades for the food demand to surpass the yield achievable by all such improvements.

(d) Natural Resources

Renewable resources such as wood, wool, and silk are being replaced to a considerable extent by synthetic materials. Our demand for many other renewable resources, however, continues to increase exponentially, and care must be taken to ensure that the harvesting rate of these resources does not exceed the ability of the resource to regenerate itself.

It is difficult to predict the depletion time of various non-renewable resources. This is true for two reasons. It is not possible to know what quantity of new reserves will be discovered, and new technology may make it economical to recover certain materials from poor-yielding sources. However, even assuming a fivefold increase in known reserves, it appears that at the current rate of increase in usage the world supply of natural gas, petroleum, gold, mercury, silver, copper and zinc will be depleted within fifty years. (1). If we are to extend the lifeline of these reserves, we will have to conserve natural gas and petroleum, and in the case of metals, restrict their unnecessary use and ensure that recycling is instituted to the fullest possible extent.

(e) Water

Fresh water is a resource which is renewable at a finite rate. The earth's land masses receive a daily average precipitation of 250 cubic kilometers of water, of which 160 ck are lost by evaporation and 100 ck return to the ocean via rivers. In many parts of the world, the shortage of fresh water is already appreciated as a serious growth-limiting factor. This is complicated by the fact that man has, unfortunately, considered flowing water a convenient receptable into which his wastes are deposited. Future technology may bring temporary relief to the problem of water shortage through desalination of sea water, but our inability to indefinitely supply an exponentially increasing

demand for water must be recognized.

(f) Pollution

Pollution is a factor which cannot only limit growth, but which can also threaten life itself. The rate of pollution generation has been increasing more rapidly than population. This is because each person consumes more products as GNP and affluence continue to rise. There are two important aspects of pollution which augment manyfold its ability to produce harmful effects.

i) Poisoning of the natural absorption system

Natural systems have the capacity to degrade or detoxify certain pollutants at a finite rate. When rate of pollutant generation exceeds the degradation rate, the excess pollutants tend to poison the system, and the degradation process stops completely.

ii) Biological Concentration

Many pollutants, although present at low levels in the physical environment, enter into natural food chains and become concentrated in the higher members of the chain (e.g., DDT, mercury). Other specific pollutants are sequestered by certain organs where they can reach hazardous concentrations (e.g., strontium 90 in bones, iodine 121 in the thyroid gland).

The future course of aggregate pollution generation will depend on the effectiveness of pollution abatement technology which is now being developed, as well as upon our ability to ultimately curtail growth. To rely upon technology alone would be a short-sighted and temporary approach to the problem.

5. Prospects for the Future

Although it is obvious that growth cannot continue indefinitely in a finite world, it is difficult to predict the pattern of consequences which will arise from continued growth. In the most comprehensive analysis to date, the Club of Rome's "Project on the

Predicament of Mankind" at the Massachusetts Institute of Technology has resulted in a computer simulation of the world system. By programming the complex inter-relationships of the many variables of the system and running the computer to simulate the passage of time, they have arrived at some predictions on the course of civilization. (1) (12). Their report, The Limits to Growth, concludes:

> "If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached some time within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity." (1).

Alteration of single parameters such as birth rate or resource usage rate resulted only in the shift of the crisis in time, or to a crisis arising from a different limiting factor. In order to achieve a steady state in the computer model, it was necessary to make substantial reductions simultaneously in birth rate, capital investment, natural resource usage and pollution generation (reductions of 30% and 75%). The book ended on the positive note that it is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied, and each person has an equal opportunity to realize his individual human potential ... If the world's people decide to strive for equilibrium rather than growth and collapse, the sooner they begin working to attain it, the greater will be their chances of success. (1).

6. Toward a Steady State

Although the magnitude of the changes needed can only be approximated at present, it is obvious that such changes will be necessary if our society is to be sustained for any reasonable length of time. The question which responsible governments must face today is - When and how should the changes be initiated?

There are two features of the system which indicate that the changes should be started as soon as possible. One is the startling rapidity with which exponential growth can exceed its limits after

coming within an order of magnitude of these limits. It appears that the human system is now within one or two doubling times of its limits, although innovation and adjustment may extend the period to some degree. The other factor indicating urgency is the phenomenon of "lag time" which is inherent in all change. For example, an immediate reduction of reproductive rate to two children per family would not have a significant effect on population growth until the year 2000 because the children who will form the reproductive base for the next thirty years have already been born.

While continuation of the present policy of growth will certainly lead to a serious crisis, the modifications necessary to stabilize the system may also have some undesirable consequences unless a well-researched transition plan is developed. For example, reduction in capital investment may lead to a temporary increase in unemployment. To offset this, capital investment should be redirected into labour-intensive industries which are not highly dependent upon resource extraction. A substantial portion of the redirected investment should go into services, arts and the development and operation of pollution abatement industries. Plans should be made for eventual actual reduction in capital investment in developed countries with a proportional increase in investment in the underdeveloped countries. These alterations of capital investments will require careful planning and organization in order to minimize the undesirable social and economic effects. A workable scheme may require reorganization of our entire life style with changes such as shorter working days for greater numbers of people.

The basic aim should be to achieve the steady state with the least amount of serious disruption, and this means taking as much time as is possible and practical. The catastrophic results of growth are a number of decades in the future. What we face now is a crisis in decision making if we are going to control growth and avoid global collapse. We must act now.

7. Value System Changes

Most actions necessary to move toward a steady state require a major change in attitude on the part of society. The actions which

are most demanding in this respect are:

reducing of birth rate

reducing of virgin resource extracting rate

reducing in pollution generation rate.

Birth rate should ideally balance death rate in the long run. In terms of immediate experience this means limiting family size to two children per family. For most families, this policy would probably be accepted if our educational system began to emphasize the advantages of smaller families and the government provided the means and incentives to this end. Fortunately, there has been a trend in this direction over the last few years.

Reduction in the resource extraction rate will require another major change in the value system of our society both on the part of the consumer and of industry. It will require the adoption of a policy of conservation which is the antithesis of the current policy. Some of the necessary changes include manufacturing of products to last as long as possible, reusing or recycling most materials, and eliminating unnecessary and wasteful products (such as non-refillable containers). In order that such changes be instituted voluntarily, the public must be made aware of the problems and then they must be willing to accept some responsibility in alleviating them. They must learn to discriminate between wasteful and economical products; they must accept somewhat higher prices on some goods to pay for pollution abatement, and they must be willing to walk a few blocks rather than drive. All of these changes are merely changes in social values, and none of them will result in significant inconvenience. In fact, under a revised economic system which internalizes social and environmental costs, such steps should actually save people money. Moreover, we believe a higher quality of life would result from such a system.

8. The Role of the Ontario Government

The Ontario government, like all governments, must now recognize the problems which will arise within its borders if unrestricted growth is allowed to continue. The provide must also acknowledge the disproportionate contribution which Ontario is making to the world's

environmental problems. Ontario now has the opportunity to assume leadership in resolving these problems by forging a new society which is not only sustainable, but equitable and desirable.

9. Recommendations

i) It is recommended that the Ontario Government initiate a vigorous program of public education designed to alert the public to the need to conserve our energy resources and minimize the environmental impact from their use.

ii) It is recommended that the Ontario Government fund an independent body of experts and leaders from a broad cross-section of society to study the very long-term consequences of continued exponential growth. The committee should study and make recommendations concerning the implications, timing and mechanisms involved in the smooth transition to a steady state.

iii) It is recommended that the Ontario Government initiate all steps required to establish a steady state as soon as they are available and are adequately planned. Some measures such as encouraging re-use and recycling, controlling product durability, promoting birth control, regulating pollution emission, conserving energy and scarce resources, etc., could be instituted immediately. Other steps, such as redirection or reduction of capital investment will require careful study before action can be taken.

REGULATION OF THE ENERGY INDUSTRIES

1. Existing Regulations

The energy industries are those which deal with energy sources or which generate and sell electrical energy. Such industries are at present subjected to varying degrees of regulation by different government agencies including the National Energy Board, the Ontario Energy Board, and environmental protection agencies such as The Ministry of the Environment and the Ministry of Natural Resources.

The National Energy Board is a body created by a 1959 Act of Parliament with responsibility to regulate and approve transactions in the oil, gas and electrical industries. The jurisdiction of this board applies mainly to international and interprovincial transactions.

The Ontario Energy Board is presently a division of the Ministry of Natural Resources and is concerned mainly with regulating gas pipelines and rates. Its terms of reference are relatively narrow, its staff small, and its decisions are not usually of general interest.

Ontario Hydro is granted relative autonomy by the Power Commission Act, although later Acts have subjected it to regulation at the operational level by certain environmental protection agencies. It remains virtually autonomous at the policy level.

2. Need for Regulation

The energy industries have the greatest potential of all industries for adversely affecting our environment and quality of life. The following are some factors which call for their regulation:

- pollution caused by the extraction, transportation, combustion and disposal of fuels
- use of land for plant sites, transmission lines and pipelines
- depletion of energy resources
- influence of energy on economic growth

a. Pollution

The transportation of fuels has a great potential for massive pollution such as oil spills. Numerous much publicized examples of this have led to contingency planning efforts. However, the emphasis should be on prevention rather than on clean-up

methods. Oil spills on land, although less newsworthy than those at sea, can be equally damaging, and special regulations should apply to pipelines where they are close to rivers or streams, or where they traverse permafrost.

The combustion of fossil fuels is the greatest factor contributing to air pollution. For example, in Metro Toronto over two-thirds of the emissions in each of the categories of sulphur dioxide, nitrogen oxides, carbon monoxides and hydrocarbons is caused by the use of the fuels by cars, power stations and furnaces (see Appendix I). Controls are being introduced for pollution from cars which will reduce emissions from this sector temporarily.

Emissions from stationery combustion sites are not adequately controlled at present. Technology is lacking for adequate emission abatement from certain fuels at electrical generating plants, and this has led to increased use of cleaner, but scarcer, fuels. In the case of burners in private homes, there is no regulation even though a certain proportion of these are maladjusted and release large quantities of partially burned fuel.

b. Land Use

As population increases, the available land space must be used more intensely, and people become more aware of intrusive structures such as transmission lines. The competition between private owners and Ontario Hydro for land rights will increase as time goes on and provision must be made for means of equitable resolution of the controversies. The problem with respect to transmission lines could be greatly reduced by under-grounding, but until technology is developed for high voltage underground conduits, some effective means of regulating routes must be developed. In addition, it is necessary to regulate the siting of power plants, oil refineries, and nuclear processing plants (if built in Canada), so as to minimize the number of people subjected to the pollution and health hazards associated with these plants.

c. Resource Depletion

Because the supply of energy fuels is limited, some program must be instituted to reserve quantities of these resources for

other uses in the future. Since the energy industries cannot be expected to voluntarily curtail their own profits by such action, it falls upon the government to regulate the rate of dissipation of these resources. The time to initiate these controls is now while the reserves are still large, rather than at the time when shortages are acute. This control will consist of defining a schedule for conversion from fossil fuels to nuclear fuels (or solar or tidal or geothermal energy). The schedule must be based on the setting aside of a defined quantity of petroleum sufficient to meet future predicted non-energy needs.

d. <u>Growth</u>

As we have seen earlier economic growth is closely associated with energy utilization and if the current exponential pattern of growth is continued, certain limits will be encountered in the next thirty to eighty years with very serious consequences to society. The continued provision of cheap, abundant energy will generate false confidence and accelerate the approach to these limits. Therefore, serious consideration should be given to regulating the rate of increase in energy utilization as a means of controlling growth rate.

3. <u>Internalization of External Costs</u>

One of the fundamental reasons for the enormous impact that the energy industries have upon the environment is the failure of our traditional economic system to include in the final price of the product the "external costs" or "external diseconomies" to the production process. Instead, these costs are passed on in hidden ways to society (the "polluted-upon") and to the environment, which is treated as a waste disposal sink and a "free good". This leads to both an artificially low price for the product and thus an excessive demand for it, as well as undesirable side-effects which, if reduced, would often result in a net public saving.

Because it is cheaper to use our air, water and land as free goods for the disposal of waste, one cannot expect private industry to account for the external costs which it imposes on society until legislation makes "internalization" mandatory and regulation enforces the law. Ontario Hydro, a public commission, should be prepared

to lead the way in this field, but has shown no willingness to do so to date.

External costs can be put into two groups - those that we can quantify in terms of dollars and those that we cannot. In the first category are all the economic effects of pollution: increased cleaning bills (for clothes, building etc.); air and water cleaning costs; loss of recreational resources; health damages (morbidity and mortality); agriculture and forest damage;fishery damage; and many others. Economists are now able to quantify many of these costs and assign a dollar value to them. These costs, though often hidden, are inevitably absorbed by the citizen through accelerated replacement times, reduced property values, higher prices for goods and services, and increased taxes to cover those costs paid by government (such as crop-loss payments, upkeep on public property, and increased health-care costs). For example, it has been estimated by the economist Richard Zerbe that in 1965 air pollution cost each citizen of Toronto $94.00 and by the year 1980 it will cost $208.00 per person(1969 dollars). (13)

In addition to those costs that can be determined, there are also those other effects of pollution to which a dollar value cannot be assigned simply because we have not yet determined a way to estimate their value in dollars. This is understandable (and perhaps even desirable in some senses) for it would mean estimating the monetary worth of such things as a crystal clear break, sweet clean air, a diverse stable ecosystem, a picturesque lake or forest, a wild river, a quiet country scene, a high quality of life, or human life itself. These considerations cannot at present be brought directly into the cost-benefit analysis, and we may never be able to do this. But they must be considered in decision making, for in many cases they are the most important as well as the most intangible factors.

We must ensure that a much wider cost accounting system is used in the future which will guarantee that external costs are internalized and enter very strongly into cost-benefit analyses. Many environmental protection steps which were previously considered by the industries to be "uneconomic" in the narrow introspective sense may suddenly become very economically desirable in the societal context. Even those that

don't show an economic "break-even" at this point may still become desirable when the aesthetic and ecological costs are considered.

4. Past Energy Policy

Given the fundamental importance of the energy industries, it is indedd tragic to study how energy policy has been determined and implemented in the Province. Ontario Hydro, whose actions affect every segment of the energy sector, has been given incredible powers which it exercises in a narrow and outdated fashion. The Commission has sweeping rights over private properties, great freedom in decision-making, and is not liable for its actions. The executive of the Commission is appointed rather than elected and is, therefore, not necessarily representative of public or parliamentary interest.

In fact, there is now a widespread recognition amongst the public and even amongst the civil service and many top administrators that Hydro has become a self-perpetuating, self-justifying, autonomous bureaucracy that is largely unaccountable to the public or the government. Except for an annual report and audit required by the Act, all business transactions and decision-making are carried out behind closed doors. Decisions on such things as power plant sites, transmission line locations, plant types and rate changes have in the past been simply announced to the public as "faits accomplis" arrived at by Hydro and other "experts" in isolation from public opinion. A process of public appeasement usually follows such announcements.

The Commission seems largely unresponsive to progressive reform from within or without and certainly suppresses information which could be used to question its present policies. It floods the public with bland propoganda and P.R. materials which always attempt to justify Hydro's position. No attempt is made to democratize its information services and its files are full of reports concerning the public interest and compiled at public (consumer) expense, which are marked "Confidential" and "Restricted".

Just as serious is the relatively unchecked power which the private energy sector seems to have had in determining the province's energy policy. The old adage that competition will lead to the best solution is no longer acceptable in this increasingly complex field. Oil remains the largest source of energy in the province and yet it is largely free of any major regulation. Surely we cannot expect an industry with so

little direct responsibility to the government or people, so much foreign ownership and so heavy a reliance upon maximizing profit to act in a manner consistent with a broadly defined public interest.

In any case, we feel that there is a need for a body to ensure that the energy industries are carrying out a predetermined provincial energy policy. As the Advisory Committee on Energy is only too well aware, the field is a complicated one which requires extensive analysis to be understood. Should no new body be appointed to replace A.C.E. after it has made its report, much of its useful work and studies will be meaningless. Many of the comments and criticisms contained in our Brief to Task Force Hydro regarding costing procedures, advertising, rate structures and other promotional techniques apply equally well to other energy industries. Indeed, many of these practices are a result of the competition between the industries, and concentrating on one particular type of energy will not solve common problems. Similarly, to exclude one or more industries from a regulatory process would be unfair to the others and distort the entire picture. A more constructive approach would seem to be to define an overall energy policy and then devise means whereby each energy industry could optimize its contribution to this policy and its objectives.

The role presently played by the government to ensure that the public interest is satisfied, leaves much to be desired. There is no single department, agency or body which is responsible for energy policy making and implementation, and the current disparate responsibilities for energy are not adequately co-ordinated. There is too little consideration of long-term factors and directions in the making of day-to-day decisions; no procedure exists whereby concerned citizens and groups can be assured of having a voice in major energy decisions; and there are no concrete guidelines on which to evaluate and assess environmental programs undertaken by the industries. And with the new principles upon which the government proposes to base its energy policy running counter to the traditional profit motive, it is particularly important that a body be designated to ensure that policy objectives are indeed implemented. In short, there do not now appear to be adequate ways of guaranteeing the protection of the public interest, and it is our opinion that many decisions in the past have run counter to the true public interest.

5. <u>Recommendations for an Energy Regulatory Board</u>

For these and other reasons, Pollution Probe recommends the establishment of a Regulatory Board to oversee the provincial energy industry and to enforce the principles which have been discussed. This Board could be created anew by legislation or the current Ontario Energy Board could be revised through legislation to embrace the new responsibilities and characteristics which will be described.

It is hoped that the deliberations of the Advisory Committee on Energy will lead the government to establish a provincial energy policy. In the past our energy policy was never formally established and became, by default, one of promotion rather than conservation. In the future, it is hoped that this area will receive more attention and that a policy-making body, such as a Cabinet Committee, will be established. While most of our Brief has been directed at policy considerations, we recognize that without an effective means of implementing this policy, industry may pay only lip service to it. Therefore, we envisage the Regulatory Board, in addition to advising the government on policy matters, as the active body charged with carrying out energy policy and checking on and evaluating the statements and activities of the energy industries.

The mere establishment of such a Board will be no means guarantee that decisions in the public interest will always be made. In order to be effective, careful attention must be given to the structure, responsibilities, powers, procedures and membership of the Board. Pollution Probe feels that if the Regulatory Board is to truly serve the public interest, it must meet the following conditions:

(a) <u>The Regulatory Board should concentrate on basic, long-range problems of energy supply and demand and should ensure that all decisions are consistent with the over-all picture.</u> The day of uncoordinated and piecemeal approaches to energy matters is over and planning, based on comprehensive analyses and studies, should play a much more important role in energy policy making and implementation. The long-term time horizon, traditionally limited to twenty to thirty years, should be extended to at least one century so that general trends and consequences can be recognized and considered in policy decisions.

(b) The Regulatory Board should be an active body responsible for overseeing the energy industries and ensuring that all its activities are in the public interest. Rather than passively deciding issues brought before it, the Board should assume responsibility for the quality and cost of energy for the consumer as well as all the effects which the industries have upon the environment and our stock of natural resources. It should be given sufficient authority and manpower to independently assess and evaluate any statement by the industries.

(c) The RegulatoryBoard should be structured and staffed to ensure that the energy industries meet public goals of economy, efficiency, reliability, public safety, internalization of external costs, preservation of the environment and conservation of natural resources. No sector within the energy industries should be considered in isolation, rather it should be appropriately encouraged or discouraged in accordance with its success in meeting these objectives. Different departments devoted to these goals should be formed. Guidelines should be established to ensure their achievement in the short and long term.

(d) The members of the Regulatory Board and its staff should represent a wide variety of specialties and career backgrounds. No longer is it necessary or desirable to draw a large proportion of Board officials from the regulated industries; and safeguards should be drawn up to limit the representation from this area. The decision-makers should include experts in ecology, medicine, engineering, sociology, law, business, and economics as well as public representatives from the locality immediately affected by any proposed actions. Because of the energy-deficient condition of our province, the Board should see its first responsibility as protecting consumers and should be so oriented.

(e) The Regulatory Board should be required to hold a public hearing when considering any major proposal and should take all necessary steps to encourage public participation in an effective manner. Concerned groups and individuals as well as the general public, should be given sufficient time and access to pertinent material so as to be able to prepare a well-reasoned and comprehensive presentation. Free legal counsel should be provided for public interest groups who wish to appear before the Board. Where particular communities will be affected by a proposal, hearings should be held at these communities to assess the feelings of local residents. Similarly, on matters of general interest, hearings should be held throughout the province so that all citizens can express their viewpoints conveniently.

(f) The Regulatory Board should appoint an Advisory Committee consisting of members representing each major interest affected by energy development and use and should consult this body in the formulation of provincial energy policies and plans. Those representing our natural resources, the environment, industry, labour, local government, academia, and domestic consumers should be included on the Committee. Such a Committee would provide for more public input into the decision-making process and hopefully ensure the maintenance of an overview of the activities of the energy industries.

The foregoing are general conditions which Pollution Probe feels an Energy Regulatory Board should satisfy if it is to represent the true public interest. The specific procedures which such a Board should follow in considering applications from the energy industries is outlined below:

(g) The Regulatory Board should be given the responsibility to:

i) Consider all proposed important actions of the provincial energy industries with authority to approve or reject the proposals.

ii) Review the operations and activities of the energy industries from time to time with authority to order changes which it feels to be in the public interest.

Important actions shall be interpreted as those which will have a direct or indirect effect on any segment of the population of the province outside the industries. These would include: design, type and location of new energy processing, production and transmission facilities, changes in the rate structure or the financing and costing techniques, modifications in public service or safety policies, new product lines, etc.

The periodic review would ensure that the industries were conforming to the long-term energy framework that had been established by the Board. It should include an examination of operating plants (fuel type, efficiency, emission control, role in system, etc.), rate structures,environmental programs, research and development expenditures, advertising approach, costing procedures and accessibility of information to the public.

(h) The Regulatory Board should require the completion and release of a comprehensive environmental impact statement prior to the making of a decision on any matter which could have a major effect on the environment. The environmental studies upon which such an impact statement are based should have been in progress for at least three years and should include a detailed analysis of the geology, geography, habitat type, indigenous flora and fauna, current or potential human usage and any particular features of the location with respect to natural usages, as well as any other considerations which the Board may require. The statement should consider both the present state of the ecological system and the changes which will occur if the project proceeds. It should consider the environmental impact of alternative solutions to the problem and should play an important role in the decision-making process.

(i) In addition, the Regulatory Board should ensure that the proposals made by the energy industries consider other criteria including: the need for action, economic basis (including a broad cost-benefit analysis of the project), technical feasibility, plant design, societal impact and other relevant matters. Each application should contain an analysis of a number of alternative solutions to the problem it faces so that the board may determine the course of action that is in the best public interest. No proposal should be approved unless the benefits derived are expected to exceed all costs. The full text of the proposal and related studies should be released simultaneously and made available to the Board, relevant government departments and agencies, other industries, municipalities that may be affected, the media, concerned groups and associations and private citizens.

(j) The Regulatory Board should then set a date, place and procedure for the public hearings to consider the application and should ensure that appropriate authorities will conduct a rigorous appraisal of the proposal. In the case of environmental considerations, these agencies should include the Ministry of the Environment (Water Quality Branch, Industrial Waste Branch, Air Management Branch, Waste Management Branch), the Ministry of Natural Resources, the Regulatory Board staff, the Ministry of Health, and the Community Planning Branch of the Ministry of Economics and Intergovernmental Affairs. The hearings should also ascertain the opinion of the citizens who will be affected by the proposed action and attempt to assess and evaluate the non-quantifiable costs of the proposed action through plebiscites, surveys and other appropriate techniques.

(k) The Regulatory Board should then make a decision on the proposed action and carefully outline the reason for that decision. If the Board wishes, it may require further studies by the applicant and defer decision until the results are available. Otherwise a positive decision will go to the Cabinet for confirmation or rejection whereas a negative decision will stand.

Pollution Probe believes that this "one-stop" system will provide the most efficient and satisfactory means of decision-making and public participation. Future decisions must be based on a broader recognition of interest and must involve experts from a variety of specialties as well as the general public. "Open planning", public responsibility, and far-sighted environmental awareness must predominate in the years to come. Only then will we ensure that our energy policy is meeting the needs of the people and is helping to improve our quality of life.

EPILOGUE

> "Men of high position are allowed, by a special act of grace, to accommodate their reasoning to the answer they need. Logic is only required in those of lesser rank."

John Kenneth Galbraith,
The Affluent Society.

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AIR QUALITY BRANCH
ONTARIO MINISTRY
OF THE ENVIRONMENT

TABLE II

AIR QUALITY MODEL FOR METROPOLITAN TORONTO

EMISSION SUMMARY - BY POLLUTANT

February, 1972 Inventory

(Percentage figures shown in brackets refer to contribution of each source type to a specific pollutant)

	Millions of Pounds Emitted Per Year				
Source Type	SO_2	PARTICULATE	NO_x	CO	HC
R. L. Hearn G.S.	34.64(7.12)	0.61(1.12)	26.38(12.74)	0.28(0.03)	0.11(0.06)
Lakeview G.S.	348.28(71.59)	5.94(10.94)	80.19(38.73)	2.00(0.23)	0.81(0.43)
Municipal Incinerators	0.55(0.11)	12.13(22.34)	1.35(0.65)	3.28(0.38)	0.16(0.09)
Industrial Sources	25.99(5.34)	12.03(22.16)	18.99(9.17)	5.29(0.62)	45.93(24.33)
Autos	3.49(0.72)	4.65(8.56)	43.65(21.08)	827.36(97.04)	126.42(66.96)
Railroads	0.40(0.08)	1.08(1.99)	2.17(1.05)	0.60(0.07)	1.33(0.70)
Shipping	0.90(0.19)	0.40(0.74)	0.66(0.32)	0.24(0.03)	0.32(0.17)
Aircraft	0.24(0.05)	1.18(2.17)	1.44(0.55)	2.21(0.26)	10.61(5.62)
Heating - Residential	19.82(4.07)	2.49(4.59)	5.91(2.85)	0.52(0.06)	0.76(0.40)
Heating - Apartments	20.05(4.12)	7.84(14.44)	10.02(4.84)	8.07(0.95)	1.68(0.89)
Heating - Schools	5.51(1.13)	0.68(1.25)	1.81(0.87)	0.27(0.03)	0.09(0.05)
Heating - Commercial Buildings	19.03(3.91)	3.39(6.24)	12.05(5.82)	0.82(0.10)	0.38(0.20)
Small Industries	7.19(1.48)	0.83(1.53)	2.54(1.23)	0.23(0.03)	0.10(0.05)
Incineration: Apartments, Schools, Small Industrial and Commercial Buildings	0.43(0.09)	1.05(1.93)	0.20(0.10)	1.44(0.17)	0.09(0.05)
TOTAL - (in brackets, % of total pollutants)	486.52(27.19)	54.30(3.04)	207.06(11.57)	852.61(47.65)	188.79(10.55)

CALCULATION OF POLLUTION PRODUCED IN HEATING AVERAGE TORONTO HOME FOR ONE YEAR

Heating Values (theoretical)[1]:

coal (bituminous)	14,000 BTU per pound
natural gas	1,000 BTU per ft^3
oil	168,000 BTU per Imperial gallon

Heat Required:

The average Toronto home uses 1000 gallons of oil per year (Imperial Oil Company information).

Therefore, 118 million BTU are required per year, assuming 70% efficiency in oil furnace (1000 x 168,000 x 0.7).

FUEL USED AND EMISSIONS PRODUCED TO YIELD 118 MILLION BTU

	Direct Use		Indirect Use (via electric heating)				
	Gas	Oil	Coal	Gas	Hydro	Nuclear	Tot
Percent	100	100	41*	3*	50*	6*	100
BTU from:	118M	118M	48.4M	3.5M	59.0M	7.1M	118M
Fuel used, 70% eff'y	169,000 ft^3	1000 gal.					
Fuel used, 35% eff'y			5 Tons	10,000 ft^3	-	-	
	$\frac{118\times10^6}{1000}\times\frac{1}{0.7}$	$\frac{118\times10^6}{168,000}\times\frac{1}{0.7}$	$\frac{48.4\times10^6}{14,000\times2000\times0.35}$	$\frac{3.5\times10^6}{1000\times0.35}$			
Pollutant[2] (lbs)							
Aldehydes	1.7	2.4	0.02	0.03	0	0	0.
CO	3.4	6.0	5.00	0.00	0	0	5.
Hydrocarbons	1.4	3.6	1.50	0.40	0	0	1.
NO_x	8.5-17	14.4	90.00	3.90	0	0	93.
SO_2	0.1	68.9**	380.00‡	0.01	0	0	380.
Particulates	3.2	12.0	7.20‡‡	0.15	0	0	7.

1. Handbook of Applied Engineering Science, Bolz, R.E., Tuve, G.L., pp. 303-306, 1970.
2. Calculated from Table VI, pg. 43, Interim Report of A.C.E. Energy and Environment Subcommittee (Ref. U.S. PHS 99-AP-2) 2nd ed., April, 1971.

* Approximate percentages for 1971 from predictions in Ontario Hydro Annual Report 1970.

** Furnace oil containing 0.4%S

‡ Coal containing 2%S

‡‡ 1.43 lb/ton of coal, based on 1971 statistics for Lakeview Generating Station: 4,162,083 tons of coal burned (Ontario Hydro information), 5,940,000 lbs of particulates emitted (Air Management Branch, February, 1972 Inventory).

APPENDIX III

HOW TO SAVE ELECTRICITY, THE ENVIRONMENT AND YOUR POCKET BOOK.

1) Don't heat your home electrically as this uses about twice as much source fuel as burning oil or gas directly in the home.

2) Don't use electric water heaters. They too are inefficient and wasteful – instead use oil or gas. Don't waste hot water.

3) Turn lights, radio, TV and other appliances off when not in use. (This also applies to lighting in office buildings and factories.)

4) Use low wattage bulbs wherever possible except in reading lamps or where close work is done. Colour walls and ceilings light so they reflect. Open drapes and blinds to let in sunlight. (It's free and non-polluting.) Use fluorescent lighting – it's more efficient.

5) Avoid frivolous and wasteful gadgets such as electric knives, garbage compactors, electric can openers, electric combs, electric hedge trimmers, etc. If you must have an electric clothes drier, use it only when the weather prohibits outside drying.

6) If you must have an air conditioner, avoid using it excessively – turn it off when no one is home or when it's not needed. Use the proper setting. Adjust window shades so that you keep out the sun in the summer and open windows to take in cool night breezes.

7) Avoid frost-free refrigerators, self-cleaning ovens and other appliances with optional extras which consume excessive amounts of electricity. If you must have a dishwasher, use only with full loads.

8) Buy recycled materials as they generally require less energy in their manufacture. Avoid: non-returnable containers; aluminum products; and synthetic materials.

9) Reduce power consumption during peak periods (breakfast and supper hours). Where possible, use electrical appliances in the evening and on weekends.

10) Make sure your house is properly insulated and constructed so as to conserve winter heat and summer cool.

11) Have fun conserving electricity for example by: sharing the light; working near each other, near windows, or outside during the day; use candles for soft evening light; go skiing or walking instead of using a sun lamp.

ONTARIO HYDRO HAS THE POWER TO ADVERTISE. YOU HAVE THE POWER TO SAY NO.

Ontario Hydro bills itself as "your biggest bargain" and as with all bargains, someone has to suffer. In this case, it's your environment. For example, the Hearn and Lakeview stations presently contribute over 78% of the sulfur dioxide, 12% of the particulates, and 51% of the nitrogen oxide emitted into Toronto's air. That's the pollution part. In the energy area, Hydro uses valuable fossil fuel and uranium resources to produce power. These resources are limited and should be conserved where possible. Furthermore, some uses of electricity are inefficient and wasteful.

Maybe Ontario Hydro should stop promoting electrical consumption and stress a policy of conservation. Maybe Hydro should include social and environmental costs in their rates. Maybe research and development should be directed toward improving efficiency and saving scarce resources.

Maybe if you take a look at some ways to save electricity, you can help your environment. Then use the coupon below to ask your Hydro something they may not have been asked before. How they plan to work for the future of the environment rather than against it.

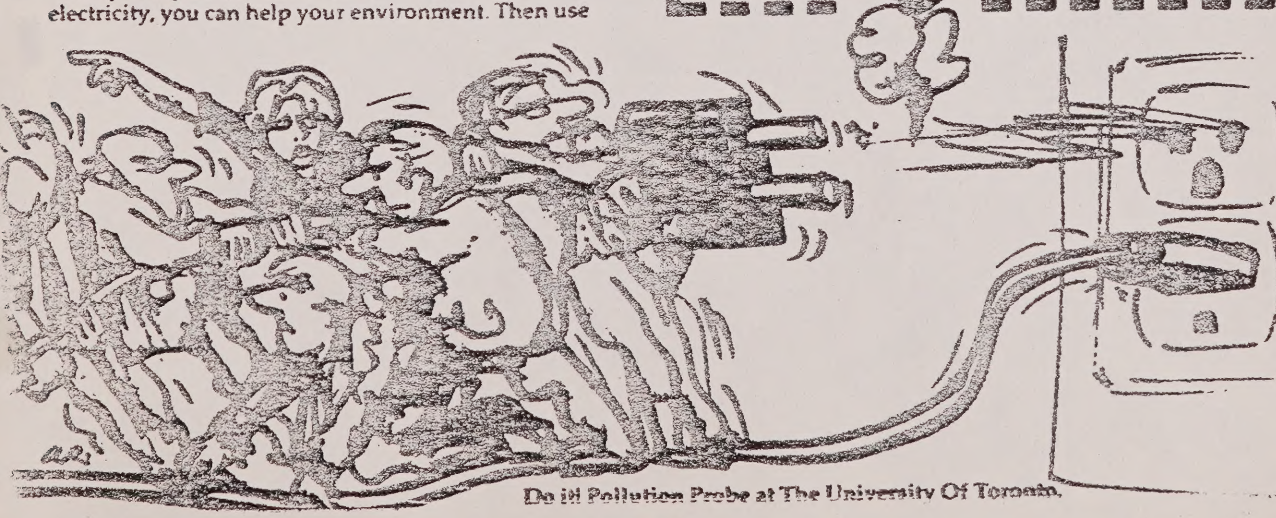
To: Mr. George Gathercole
Chairman, Ontario Hydro, 620 University Avenue
Toronto, Ontario.

I'm trying to do my part to help conserve energy and protect our environment. I'd like to know what Hydro's doing in these areas:

NAME

ADDRESS

CITY OR TOWN



Do it! Pollution Probe at The University Of Toronto.